FIGURE 1

INSTRUCTION

201a RULE OPCODE

201b PATTERN

201c MASK

201d LOCATION/CONTROL START

201e END

DATA GEN.

213

LOAD PATH

212

211 ADDR GEN

ADDRESS DECODE

B1 B2 B3 B4 B5 B6 B7 B8
B2 B3 B4 B5 B6 B7 B8 B9
B3 B4 B5 B6 B7 B8 B9 B10
B4 B5 B6 B7 B8 B9 B10 B11
B5 B6 B7 B8 B9 B10 B11 B12
B6 B7 B8 B9 B10 B11 B12 B13
B7 B8 B9 B10 B11 B12 B13 B14
B8 B9 B10 B11 B12 B13 B14 B15

B1 B2 B3 B4 B5 B6 B7 B8 B9 B10 ... B24

SEARCH REGISTER 202a

SEARCH ARRAY 202c

SORT

RESULT

203

SORT UNIT 202b

SEARCH EXECUTION HARDWARE 202

FIGURE 2A

Mask ~201c

/8 ~311

Match1

Match2

Match2k

Row & Mask Resolver

Row & Mask Resolver

Row & Mask Resolver

$310_{1(1-8)}$

$310_{2(1-8)}$

Byte 8

Byte 8
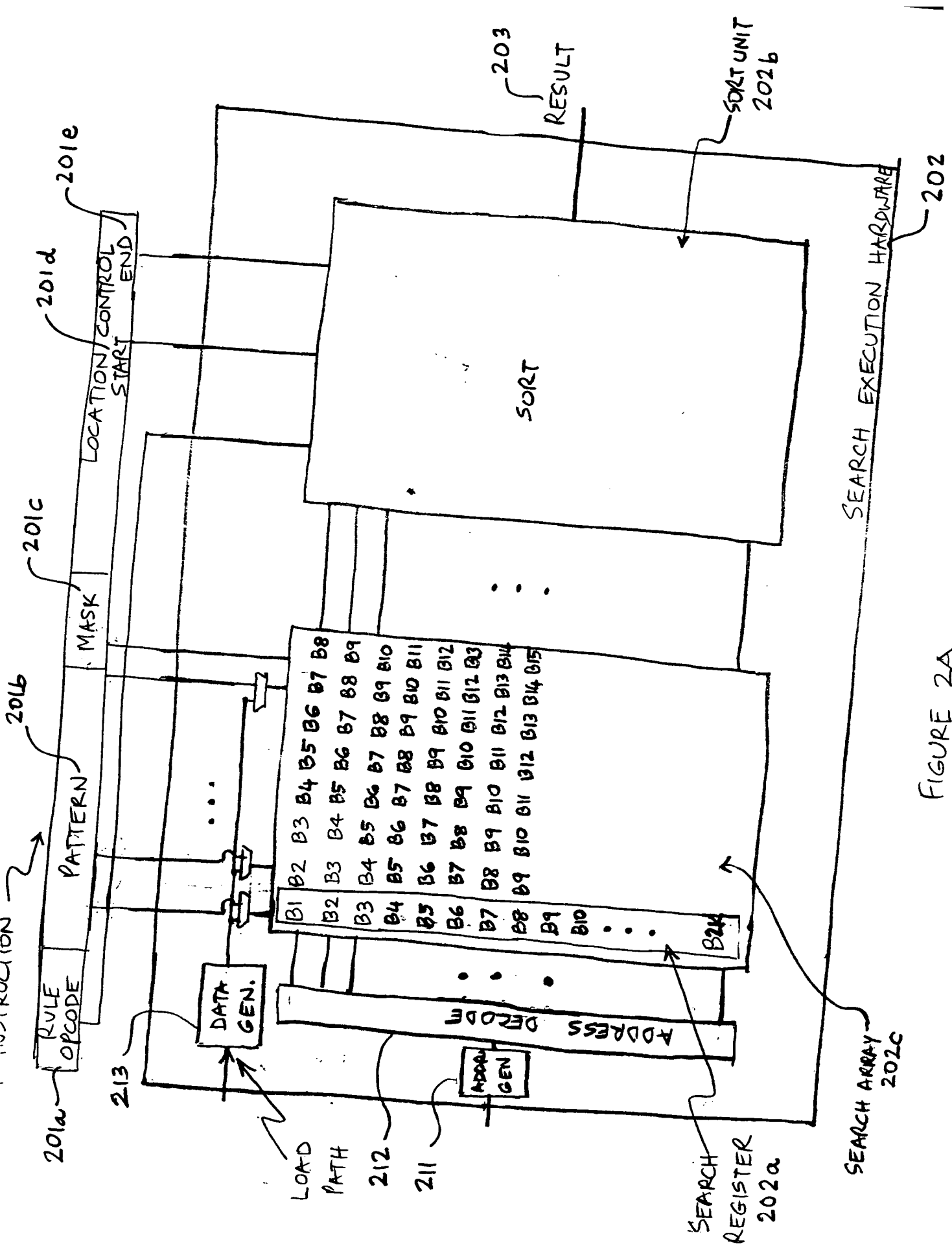
Byte 8

Byte 2

Byte 2

Byte 2

Byte 1

Byte 1

Byte 1
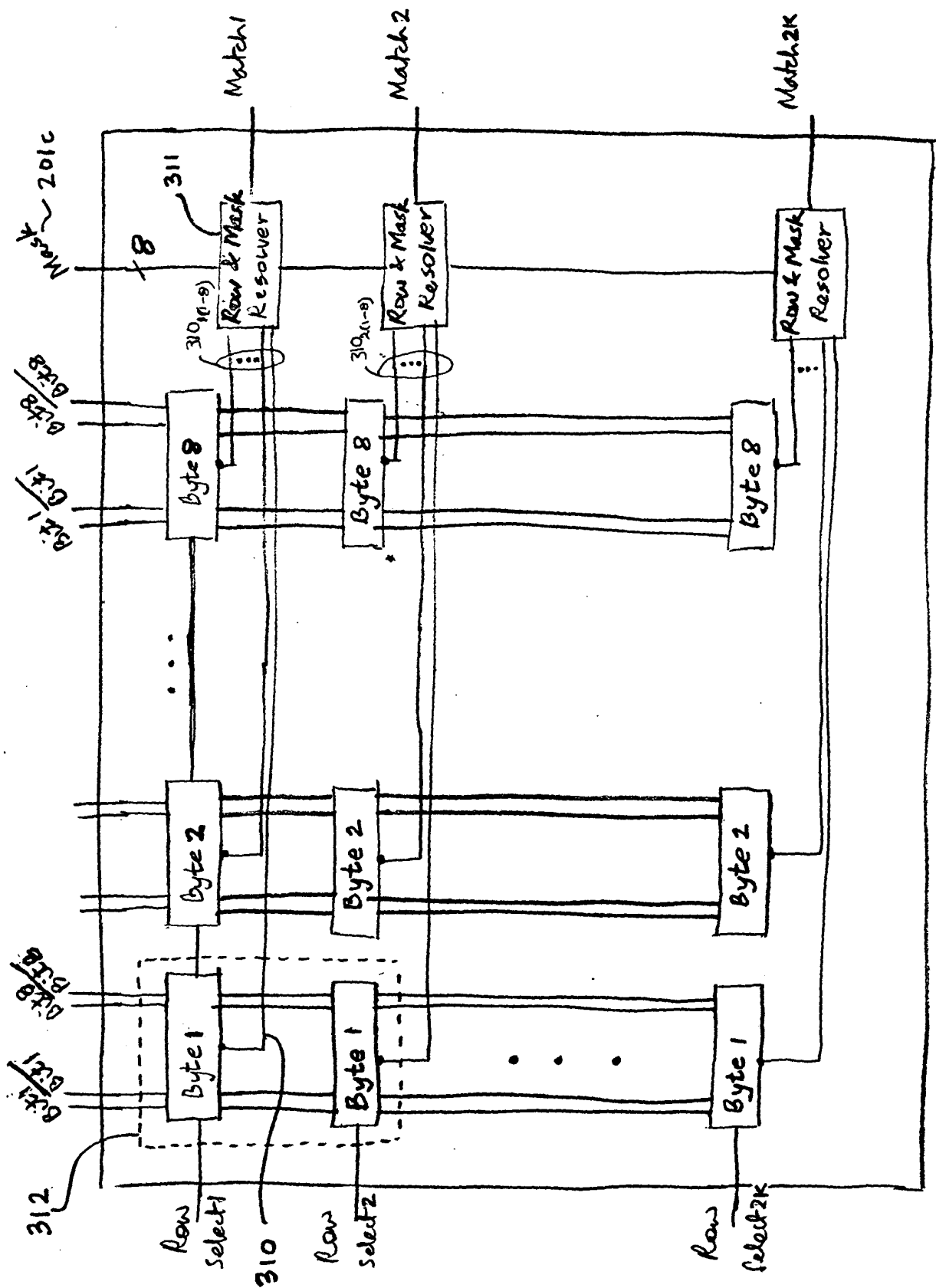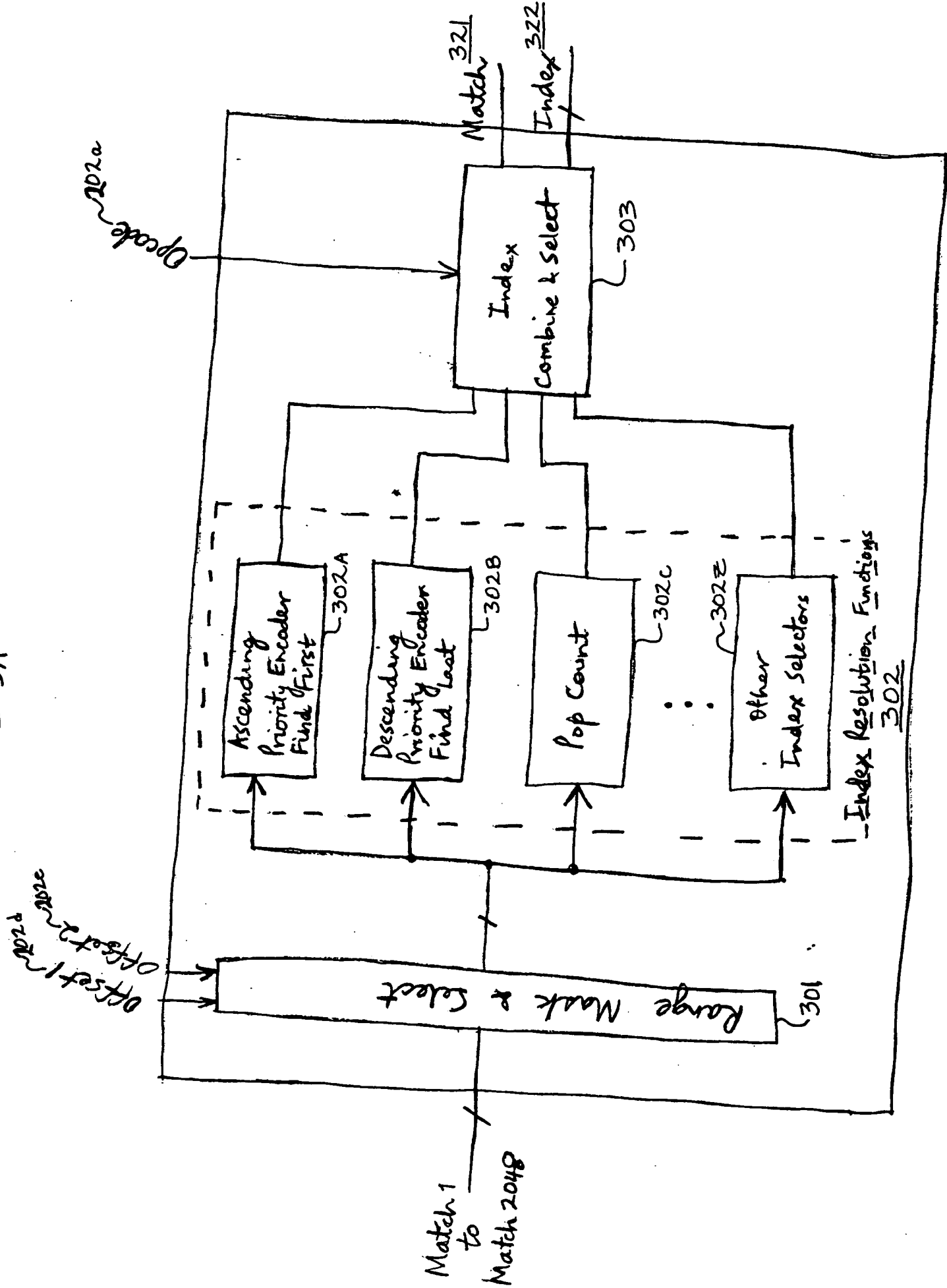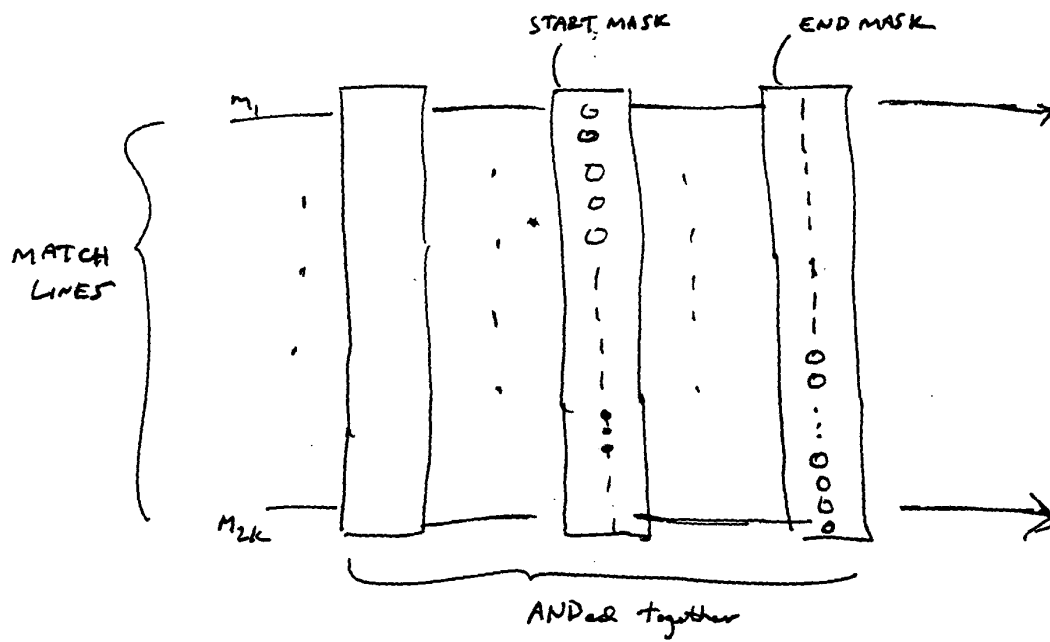
312

Row select1

310

Row select2

Row select2k

FIGURE 2B
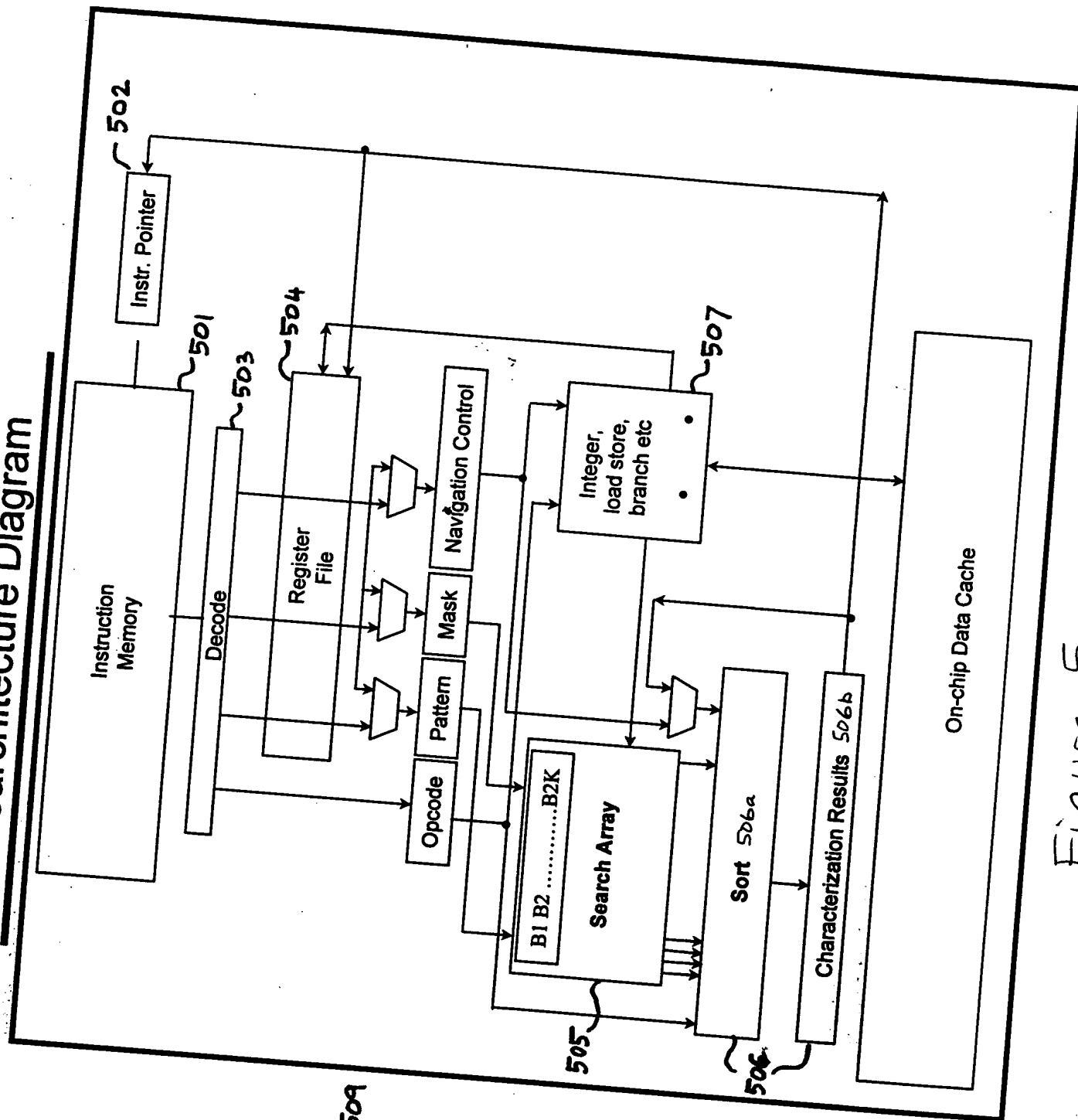
FIGURE 3A

Figure 3B
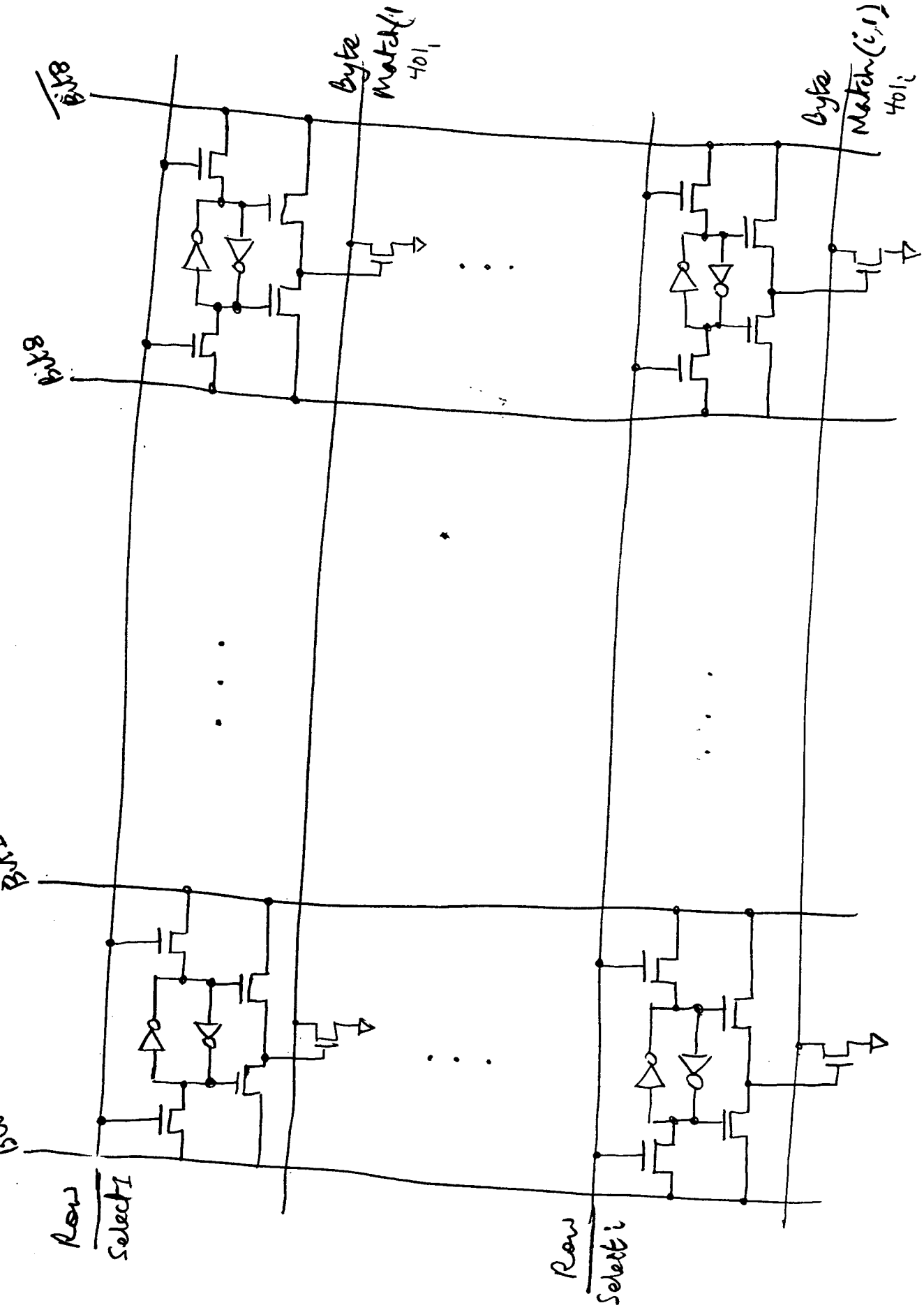
FIGURE 4

# Microarchitecture Diagram



Figure 5

# Example pseudo-code and Rule Engine micro-code

## Pseudo-code  601

*FIND ((("cp /bin/sh /usr/spool/mail/root" BEFORE "chmod 4755 !$") AND "touch") BEFORE "mail"*

## Micro-code for an exemplary Rule Engine

602

| | Opcode | Pattern | Mask | Start Offset | Start Offset Indirect | End Offset | End Offset Indirect | Result Register | Branch Address |
|---|---|---|---|---|---|---|---|---|---|
| 1 | FIND_FIRST_FORWARD | "cp /bin/" | 0xFF | 0x03D | 0 | 0x800 | 0 | A | 0xB |
| 2 | FIND_FORWARD_ANCHORED | "sh /usr" | 0xFF | <A + 8> | 1 | 0x800 | 0 | A | 0xB |
| 3 | FIND_FORWARD_ANCHORED | "spool/ma" | 0xFF | <A + 8> | 1 | 0x800 | 0 | A | 0xB |
| 4 | FIND_FORWARD_ANCHORED | "il/root" | 0xFE | <A + 8> | 1 | 0x800 | 0 | A | 0xB |
| 5 | FIND_FIRST_FORWARD | "chmod 47" | 0xFF | <A + 7> | 1 | 0x800 | 0 | A | 0xB |
| 6 | FIND_FORWARD_ANCHORED | "55 !$" | 0xF8 | <A + 8> | 1 | 0x800 | 0 | A | 0xB |
| 7 | FIND_FIRST_FORWARD | "touch" | 0xF8 | 0x03D | 0 | 0x800 | 0 | B | 0xB |
| 8 | CMP(B+5, A+5)_BRANCH(10) | - | - | - | - | - | - | - | 0xA |
| 9 | FIND_FIRST_FORWARD | "mail" | 0xF0 | <A + 5> | 1 | 0x800 | 0 | C | 0xB |
| 10 | FIND_FIRST_FORWARD | "mail" | 0xF0 | <B + 5> | 1 | 0x800 | 0 | C | 0xB |

603

604

FIGURE 6

# Execution of example micro-code: pipeline diagram

| 701 | Clock 1 | Clock 2 | Clock 3 | Clock 4 | Clock 5 | Clock 6 | Clock 7 | Clock 7 | Clock 8 | Clock 9 | Clock 10 | Clock 11 | Clock 12 | Clock 13 | Clock 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fetch | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | - | - | - | 10 | - | - | - |
| Assemble | - | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | - | - | - | 10 | - | - |
| Search/Execute | - | - | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | - | - | - | 10 | - |
| Sort & Branch | - | - | - | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | - | - | - | 10 |

FIGURE 7